Upper Salmon River Spring Chinook Salmon Population
Population Viability Assessment

The Upper Salmon River chinook population (Figure 1) is part of the Snake River Spring/Summer Chinook ESU which has five major population groupings (MPGs), including: Lower Snake River, Grande Ronde / Imnaha, South Fork Salmon River, Middle Fork Salmon River, and the Upper Salmon River group. The ESU contains both spring and summer run chinook. The Upper Salmon River population is a spring run and is one of eight extant populations in the Upper Salmon River MPG.

The ICTRT classified the Upper Salmon River population as a "large" population (Table 1) based on historical habitat potential (ICTRT 2005). A chinook population classified as large has a mean minimum abundance threshold criteria of 1000 naturally produced spawners with a sufficient intrinsic productivity to achieve a 5% or less risk of extinction over a 100-year timeframe.

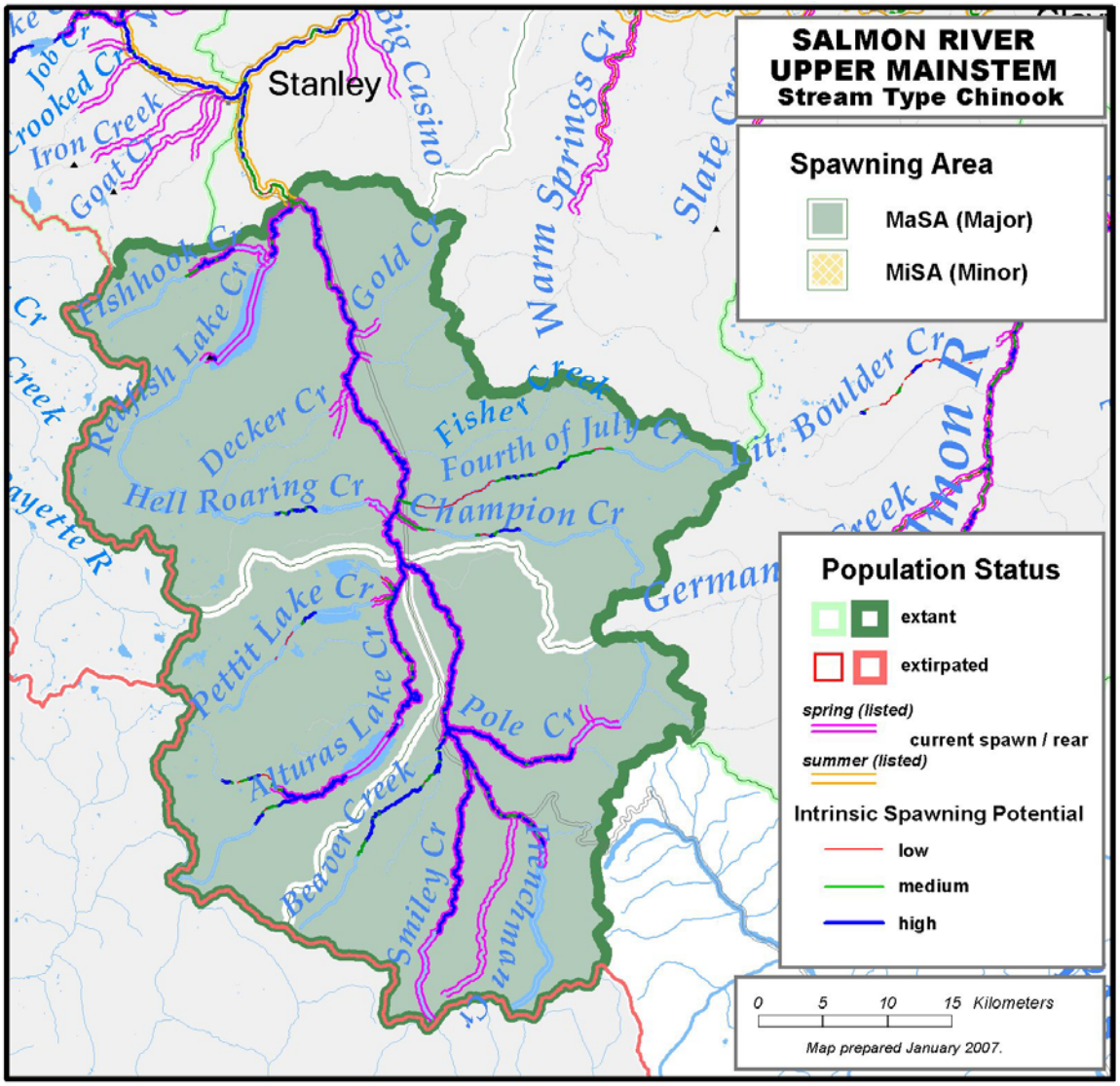

Figure 1. Upper Salmon River chinook major and minor spawning areas.

Table 1. Upper Salmon River chinook basin statistics

Drainage Area (km2)	902
Stream lengths km* (total)	324
Stream lengths km* (below natural barriers)	295
Branched stream area weighted by intrinsic potential (km2)	0.741
Branched stream area km2 (weighted and temp. limited)	0.741
Total stream area weighted by intrinsic potential (km2)	0.692
Total stream area weighted by intrinsic potential (km2) temp limited	0.692
Size / Complexity category	Large / "C" (trellis pattern)
Number of MaSAs	3
Number of MiSAs	0

*All stream segments greater than or equal to 3.8m bankfull width were included
**Temperature limited areas were assessed by subtracting area where the mean weekly modeled water temperature was greater than 22^{o}C.

Current Abundance and Productivity

Current (1962 to 2005) abundance (number of adults spawning in natural production areas) has ranged from 18 in 1995 to 3,554 in 1978 (Figure 2). Annual abundance estimates for the Upper Salmon River were based on expanded redd counts (1962-1980) and Sawtooth Hatchery weir counts (1981-2005). Annual abundance estimates for the Upper Salmon River population were based on expanded redd counts. IFDG has surveyed eleven index areas within the Upper Salmon drainage for spring and summer chinook spawning. We partitioned the index areas by Major Spawning Area and expanded from index area redd counts to total redd counts within each of those MaSAs, based on ratios of total weighted spawning area within index areas versus within the associated MaSA.

The lower mainstem MaSA estimate was based on counts in IDFG index areas 16 and 15 (mainstem reaches from Sunny Gulch to the confluence with Redfish Lake Creek). The total distance surveyed among these index areas was relatively constant from year to year. We summed the redd counts across the index reaches within this MASA for each year, and expanded by the ratio of total weighted habitat to index area weighted habitat (1.27) to generate annual estimates of the total redds within this MaSA.

The Alturas Lake Creek drainage represents a second MaSA, the associated IDFG index areas were NS-12, OS-1, OS-2 and OS-3. The total number of index kilometers varied among years and the OS index areas were not surveyed until 1985. We adjusted each years count to the total index kilometers and expanded that result by the ratio of index weighted area habitat to total weighted area habitat within the MaSA (1.31).

Tributary and mainstem habitat above the Alturas Lake Creek confluence is a third MaSA, with associated IDFG index areas NS-15c, NS-13 a&b (Pole Creek), OS-5 and OS-6. Redd counts in Pole Creek and the upper sections of the mainstem were consistently lower than counts in the lower mainstem section (index area 15c). The median ratio of redds/km for the upper index areas relative to the lower mainstem was .113. Assuming that the upper counts were more representative of all of the tributary habitat above Breckenridge, we generated a weighted expansion factor (2.72). Based on these assumptions, we generated estimates of the total redds in the lower MaSA by multiplying the annual 15c mainstem index area counts by this factor.

We summed expanded redd counts over the three MaSAs and applied the Middle Fork average fish per redd (1.82) to generate estimates of the number of spawners in the Upper Salmon River spring/summer chinook population.

Recent year natural spawners include returns originating from naturally spawning parents, and hatchery fish that originate from the Sawtooth Fish Hatchery located on the Salmon River approximately one mile upstream of Redfish Lake Creek. A weir at the hatchery location is used to trap salmon and regulate the number of hatchery fish passed upstream. Since the early 1990s only natural origin fish and supplementation program adults were passed upstream to spawn naturally. Fish returning as part of the harvest augmentation program (hatchery x hatchery crosses) are not released above the weir. Fish spawning downstream of the weir include natural origin, hatchery origin, and potentially some of the supplementation program adults. There are no efforts to regulate the composition of spawners downstream of the weir. Spawners originating from naturally spawning parents have comprised an average of 89% since 1962, while the 10-year recent average is 75% (Table 2).

Abundance in recent years has been highly variable, the most recent 10-year geomean number of natural origin spawners was 268 (Table 2). During the period 1981-2005, returns per spawner for chinook in the Upper Salmon River ranged from 0.14 in 1990 to 16.55 in 1983. The most recent 20 year (1981-2000) SAR adjusted and delimited geometric mean of returns per spawner was 1.47 (Table 2).

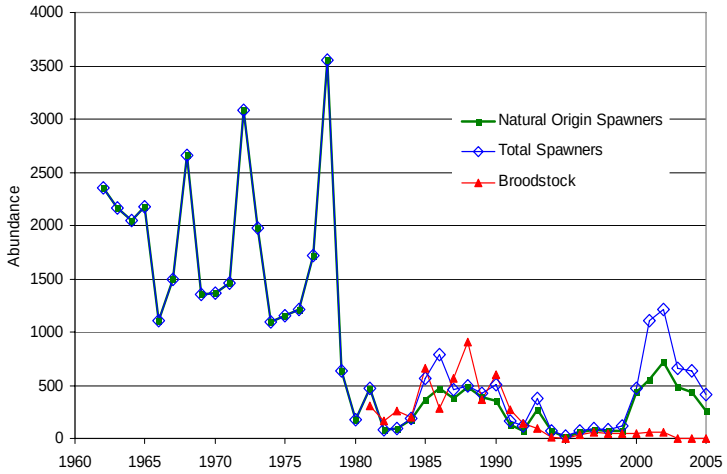

Figure 2. Upper Salmon River abundance trends 1962-2005, based on expanded redd counts..

Table 2. Upper Salmon River abundance and productivity measures

10-year geomean natural abundance	268
20-year return/spawner productivity	1.50
20-year return/spawner productivity, SAR adj. and delimited*	1.47
20-year Bev-Holt fit productivity, SAR adjusted	4.48
20-year Lambda productivity estimate	1.06
Average proportion natural origin spawners (recent 10 years)	0.75
Reproductive success adj. for hatchery origin spawners	n/a

*Delimited productivity excludes any spawner/return pair where the spawner number exceeds 75% of the size category threshold for this population. This approach attempts to remove density dependence effects that may influence the productivity estimate.

Comparison to the Viability Curve

- Abundance: 10-yr geomean natural origin spawners
- Productivity: 20-yr geomean R/S (adjusted for marine survival and delimited at 750 spawners)
- Curve: Hockey-Stick curve
- Conclusion: The Upper Salmon River chinook population is at **HIGH** risk based on current abundance and productivity. The point estimate resides below the 25% risk curve (Figure 3).

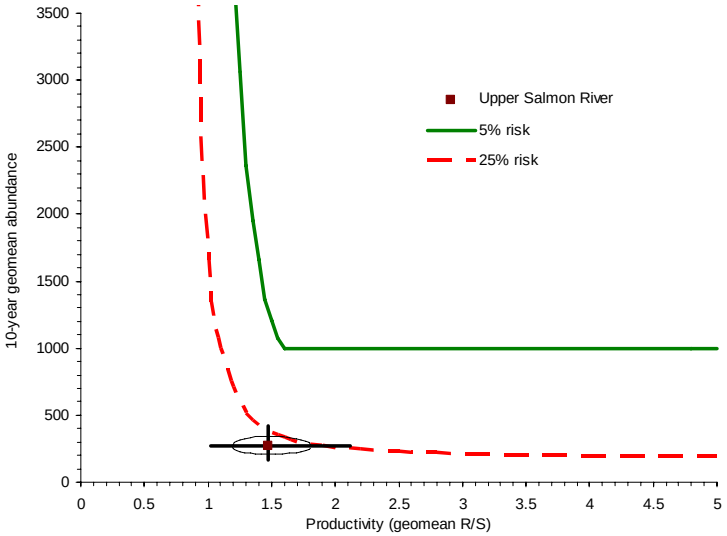

Figure 3. Upper Salmon River Spring Chinook abundance and productivity metrics against a Hockey-Stick viability curve. Dataset adjusted for marine survival and delimited at 750 spawners. Estimate includes a 1 SE ellipse, 1.81 X SE abundance line, and 1.73 X SE productivity line.

Spatial Structure and Diversity

The ICTRT has identified three major spawning areas (MaSAs) and no minor spawning areas (MiSA) within the Upper Salmon River chinook population. There are no modeled temperature limitations within this MaSA. Spawning is distributed broadly throughout the population boundaries including the mainstem and numerous tributaries. Tributaries most used by Chinook salmon for spawning include Beaver Creek, Frenchman Creek, Pole Creek and Alturas Lake Creek although historically and currently most spawning occurs in the mainstem Salmon River.

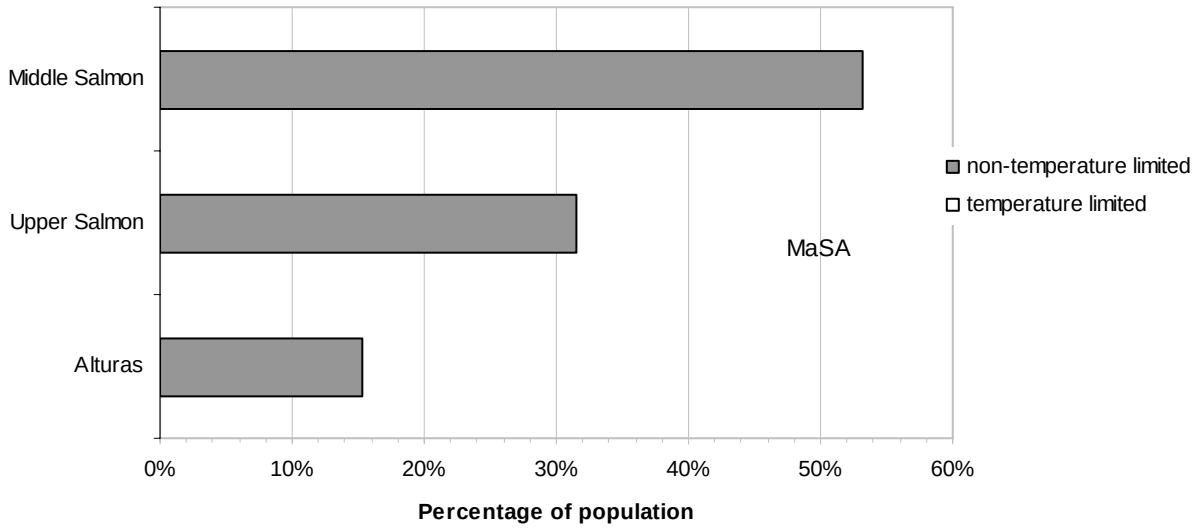

Figure 4. The Upper Salmon River Spring Chinook population contains three MaSAs, and no MiSAs. There are no modeled temperature limitations within this population.

Factors and Metrics

A.1.a. Number and spatial arrangement of spawning areas.
The Upper Salmon Mainstem Chinook population has three MaSAs (Alturas, Upper Salmon, and Middle Salmon) and no MiSAs. The total branched stream area weighted by intrinsic potential is 741,467 m^2, an area equivalent to 7.4 MaSAs. This metric is rated *Very Low Risk* even though no intrinsic habitat lies outside of the MaSAs because of the large amount of area in the three MaSAs in a non-linear configuration.

A.l.b. Spatial extent or range of population.
The IDFG has conducted annual spawner index counts since 1957 within the boundaries of this population from Redfish Lake Creek upstream to just above Frenchman Creek. Also, reaches in Pole Creek and Alturas Lake Creek have been surveyed. This metric is rated V*ery Low Risk* because current spawning distribution mirrors historical and the historical range has not been reduced. All MaSAs are occupied at both the lower and upper ends based on recent spawner surveys.

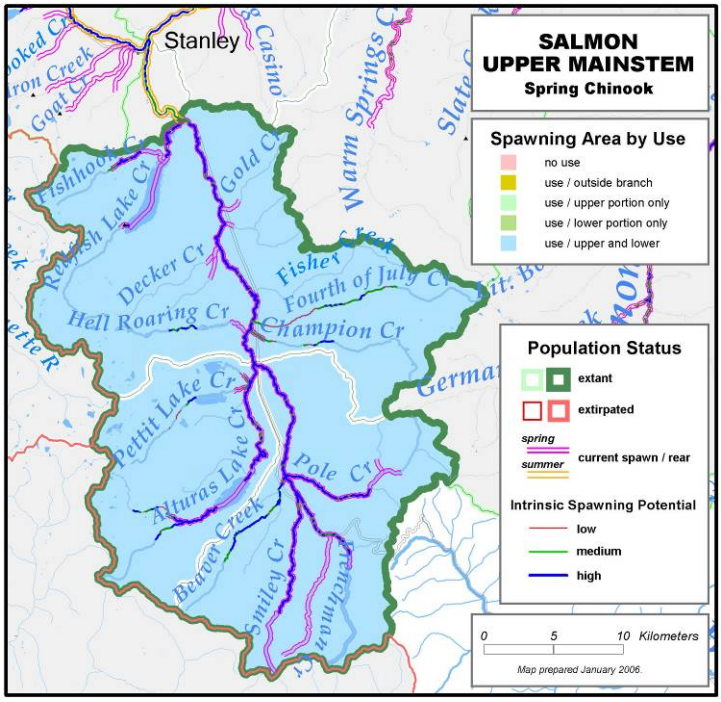

Figure 5. Upper Salmon River chinook distribution.

A.1.c. Increase or decrease in gaps or continuities between spawning areas.
There has been no change in gaps when comparing current and historical spawning distribution. The population is rated at *Very Low* risk because all historical MaSA are occupied, gap distance and continuity have not changed, and there has been no increase in distance between this population and other populations in the MPG or ESU.

B.1.a. Major life history strategies.
There are limited data to allow any comparisons between historic and current life history strategies. The IDFG classifies the entire population as spring run. The known major juvenile life history strategy is a spring yearling migrant to the ocean, but a large proportion of juveniles leave their natal rearing habitat as fall presmolts. No natural or anthropogenic impacts that could have resulted in loss of a life history strategy are known to have occurred. Adult spawners still

occupy all reaches of the stream. It appears all historic juvenile and adult life history strategies are present, but because data is limited the metric is rated *Low Risk.*

B.1.b. Phenotypic variation.

There is no data to indicate that any phenotypic traits have been significantly changed or lost. No alterations of within-basin habitat conditions that could have resulted in loss of a phenotypic trait are known to have occurred. No major selective pressures exist which would cause significant changes in or loss of traits. Recent PIT-tag data indicates time of smolt arrival at Lower Granite Dam differences among smolts emigrating from different parts of the basin. Frenchman Creek samples have significantly later arrival at Lower Granite than Alturas Lake samples (ICTRT 2003). Changes in the mainstem migration corridor (lower Snake and Columbia rivers) likely have altered timing of juvenile downstream passage and adult upstream passage. Because smolt entry into the estuary is substantially delayed relative to historic conditions, this metric is rated at *Low Risk.*

B.1.c. Genetic variation.

Genetic ratings were based on IC-TRT analysis of allozyme data presented in Waples et al. 1993. In addition, the IC-TRT analyzed WDFW and R. Waples, unpublished allozyme data, and P. Moran, unpublished microsatellite data. Among population variation showed potential homogenization due to similarity to Sawtooth Hatchery samples. This population clusters with other Upper Salmon River MPG populations. Alturas Lake Creek samples are highly differentiated from other upper Salmon River samples. This metric was rated *Moderate Risk.*

B.2.a. Spawner composition.

Spawner composition is mainly determined from recovery of tags from fish trapped at the Sawtooth Hatchery. Any marked fish that are recovered are examined for the presence of a coded-wire or PIT tag. From 1981 through 2004 3,955 marked fish were recovered from the population and a CWT was extracted and read from 3,932 of those fish.

(1) *Out-of-ESU strays*. Four out-of-ESU strays were recovered at the Sawtooth Hatchery across the 23 years of data reviewed. Two were fall Chinook that had been reared in the Hagerman Valley, one was a stray from the Tucannon River and one was a stray from the Umatilla River. Those four fish most likely were spawned in the hatchery, thus did not spawn naturally. No expansions were done to account for unmarked returns from the respective mark groups. This sub-metric is rated *Very Low* risk since no strays have been observed in recent years and the total number observed was very low.

(2) *Out-of-MPG strays from within the ESU*. Five out-of-MPG strays were recovered at the Sawtooth Hatchery across the 23 years of data reviewed. Two of the strays were Rapid River origin and two were South Fork Salmon River origin. This sub-metric is rated *Low* risk.

(3) *Out of population within MPG strays*. Six out-of-population strays were recovered at the Sawtooth Hatchery across the 23 years of data reviewed. Three of the strays were East Fork Salmon River origin and three were Pahsimeroi River origin. This sub-metric is rated *Low* risk.

(4) *Within-population hatchery spawners.* Hatchery-origin spawners that have been observed in the population in recent years originated from the within-population Sawtooth Fish Hatchery mitigation program. Proportion of hatchery spawners observed has ranged from 0% to 50% per year upstream of the hatchery weir, and averaged 25% over the last ten years. The proportion of hatchery fish spawning between the weir and Redfish Lake Creek is unknown but likely high in some years. The mitigation hatchery program is characterized as best management practices based on the following:

- mating protocols maximize the number of family groups annually,
- there is no culling or grading of parr or smolts,
- hatchery smolts are released only in the vicinity of the hatchery weir,
- hatchery brood stock was found from local origin fish, and
- the number and proportion of hatchery fish spawning naturally above the weir are managed through a supplementation research program.

Given that best management practices are used and the average hatchery fraction has been 25% over two generations, this sub-metric is rated *Moderate Risk.*

The overall risk rating for metric B.2.a “spawner composition” is *Moderate Risk* because of the naturally spawning within population hatchery origin fish.

B.3.a. Distribution of population across habitat types.

The Upper Salmon River Mainstem population intrinsic potential distribution historically was distributed across two EPA level IV ecoregions, with High Glacial Drift Valleys being predominant. The current distribution is nearly identical to the historic intrinsic distribution (Table 3 and Fig. 6). There are no substantial changes in ecoregion occupancy and this metric was rated *Low Risk* for the population. This is the lowest risk rating the population can achieve for this metric since historically only two ecoregions were represented.

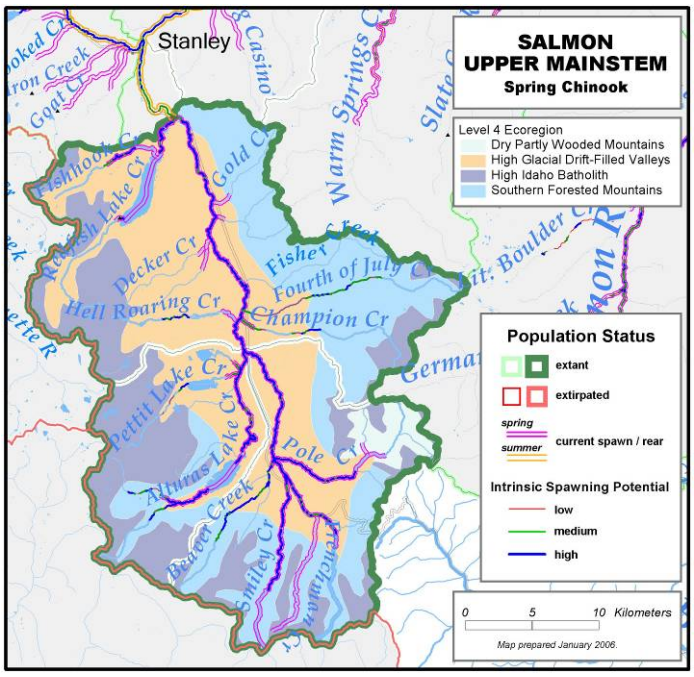

Figure 6. Upper Salmon River chinook population distribution across various ecoregions.

Table 3. Upper Salmon River chinook—proportion of spawning areas across various ecoregions.

Ecoregion	% of historical branch spawning area in this ecoregion (non-temperature limited)	% of historical branch spawning area in this ecoregion (temperature limited)	% of currently occupied spawning area in this ecoregion (non-temperature limited)
High Glacial Drift-Filled Valleys	89.4	89.4	93.2
Southern Forested Mountains	10.6	10.6	6.8

B.4.a. Selective change in natural processes or selective impacts.

Hydropower system: The hydrosystem and associated reservoirs impose some selective mortality on smolt outmigrants and adult migrants, the selective mortality is not likely to remove more than 25% of the affected individuals. The likely impacts are rated as *Low Risk* for this action.

Harvest: Recent harvest rates for spring/summer Chinook salmon are generally less than 10% annually. There are no freshwater fisheries directly targeting wild spring/summer Chinook salmon; indirect mortalities are expected to occur in some fisheries selective for hatchery fish. It is not likely that the incidental mortality is selective for a particular group of fish or if it is, it

would not select 25% or more of that particular group, therefore this action was rated as *Very Low* risk.

Hatcheries: A hatchery mitigation program has been operated in the population since 1984, and a supplementation research program is ongoing since 1991. Selection is avoided in both of those programs, and the selective impact of hatchery actions was rated as *Low* risk.

Habitat: Habitat changes resulting from land use activities in the basin may impose some selective mortality, but the extent is unknown. It is likely that any selective mortality impacts would affect a non-negligible portion of the population. Dewatering of some tributaries as a result of irrigation withdrawals forces fish to utilize other areas for spawning and rearing. It is not known if that results in a selective impact on the population. This selective impact was rated *Low Risk*.

Spatial Structure and Diversity Summary

Overall spatial structure and diversity has been rated *Moderate Risk* for the Upper Salmon River Mainstem population (Table 4). The lowest spatial structure/diversity risk level the population could achieve would be Very Low risk because of the historic (natural) number and spatial arrangement of spawning areas and large total amount of intrinsic potential habitat. The current *Moderate* risk rating is driven by the rating for genetic variation, which is influenced by hatchery fish in the system. Also, spawner composition in the population also rated moderate risk because of the relatively high proportion of hatchery fish spawning naturally.

Table 4. Spatial structure and diversity scoring table

<table>
<tr><th rowspan="2">Metric</th><th colspan="5">Risk Assessment Scores</th></tr>
<tr><th>Metric</th><th>Factor</th><th>Mechanism</th><th>Goal</th><th>Population</th></tr>
<tr><td>A.1.a</td><td>VL (2)</td><td>VL (2)</td><td rowspan="3">Very Low Risk (Mean=2)</td><td rowspan="3">Very Low Risk</td><td rowspan="14">Moderate Risk</td></tr>
<tr><td>A.1.b</td><td>VL (2)</td><td>VL (2)</td></tr>
<tr><td>A.1.c</td><td>VL (2)</td><td>VL (2)</td></tr>
<tr><td>B.1.a</td><td>L (1)</td><td>L (1)</td><td rowspan="3">Moderate Risk</td><td rowspan="9">Moderate Risk</td></tr>
<tr><td>B.1.b</td><td>L (1)</td><td>L (1)</td></tr>
<tr><td>B.1.c</td><td>M (0)</td><td>M (0)</td></tr>
<tr><td>B.2.a(1)</td><td>VL (2)</td><td rowspan="4">Moderate Risk</td><td rowspan="4">Moderate Risk</td></tr>
<tr><td>B.2.a(2)</td><td>L (1)</td></tr>
<tr><td>B.2.a(3)</td><td>L (1)</td></tr>
<tr><td>B.2.a(4)</td><td>M (0)</td></tr>
<tr><td>B.3.a</td><td>L (1)</td><td>L (1)</td><td>L (1)</td></tr>
<tr><td>B.4.a</td><td>L (1)</td><td>L (1)</td><td>L (1)</td></tr>
</table>

Overall Viability Rating

The Upper Salmon River Mainstem spring/summer Chinook salmon population does not currently meet viability criteria because Abundance/Productivity risk is high (Table 5). The 20-year delimited recruit per spawner point estimate (1.47) satisfies the 1.45 minimum required at the threshold abundance. The 10-year geometric mean abundance is 27% of the minimum threshold abundance. Improvement in abundance/productivity status (reduction of risk level) will need to occur before the population can be considered viable. Also, the population currently does not meet the criteria for a "maintained" population.

		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	HV	HV	V	M
	Low (1-5%)	V	V	V	M
	Moderate (6 – 25%)	M	M	M	
	High (>25%)			Upper Salmon R.	

Figure 7. Viable Salmonid Population parameter risk ratings for the Upper Salmon River Spring Chinook population. This population does not currently meet viability criteria. *Viability Key: HV – Highly Viable; V – Viable; M – Maintained; Shaded cells-- not meeting viability criteria (darkest cells are at greatest risk)*

Upper Salmon River Chinook – Data Summary

Data type: Sawtooth hatchery weir counts
SAR: Averaged Williams/CSS series

Table 5. Upper Salmon River Chinook run data (used for curve fits and R/S analysis). All available return/spawner data were used since the parent escapement never exceeded 75% of the size threshold.

Brood Year	Spawners	%Wild	Natural Run	Nat. Rtns	R/S	Rel. SAR	Adj. Rtns	Adj. R/S
1981	**476**	**100%**	**746**	**1055**	**2.22**	**0.63**	**663**	**1.39**
1982	**88**	**100%**	**236**	**1058**	**12.00**	**0.51**	**541**	**6.14**
1983	**99**	**100%**	**329**	**1638**	**16.55**	**0.58**	**944**	**9.53**
1984	**185**	**98%**	**356**	**212**	**1.15**	**1.65**	**351**	**1.90**
1985	**563**	**64%**	**958**	**316**	**0.56**	**1.57**	**496**	**0.88**
1986	788	60%	734	1388	1.76	1.41	1960	2.49
1987	**455**	**83%**	**884**	**244**	**0.54**	**1.83**	**445**	**0.98**
1988	**497**	**98%**	**1298**	**463**	**0.93**	**0.75**	**346**	**0.70**
1989	**423**	**93%**	**722**	**63**	**0.15**	**1.79**	**113**	**0.27**
1990	**501**	**71%**	**897**	**72**	**0.14**	**4.65**	**335**	**0.67**
1991	**170**	**76%**	**367**	**30**	**0.17**	**3.01**	**89**	**0.53**
1992	**120**	**62%**	**202**	**141**	**1.18**	**1.65**	**234**	**1.95**
1993	**374**	**72%**	**356**	**158**	**0.42**	**1.61**	**253**	**0.68**
1994	**69**	**95%**	**78**	**68**	**0.99**	**1.04**	**71**	**1.03**
1995	**18**	**90%**	**17**	**128**	**7.09**	**0.60**	**77**	**4.25**
1996	**68**	**95%**	**95**	**511**	**7.57**	**0.54**	**278**	**4.12**
1997	**89**	**94%**	**140**	**844**	**9.47**	**0.30**	**250**	**2.80**
1998	**83**	**90%**	**114**	**773**	**9.33**	**0.30**	**230**	**2.77**
1999	**115**	**63%**	**110**	**174**	**1.51**	**0.65**	**113**	**0.98**
2000	**473**	**92%**	**481**	**464**	**0.98**	**1.00**	**464**	**0.98**
2001	1108	50%	603					
2002	1206	59%	767					
2003	658	74%	484					
2004	638	68%	435					
2005	408	62%	253					

Table 6. Geomean abundance and productivity measures. Boxed values were used in evaluating the current status of this population.

	R/S measures				Lambda measures		Abundance
	Not adjusted		SAR adjusted		Not adjusted		Nat. origin
delimited	median	75% threshold	median	75% threshold	1989-2000	1981-2000	geomean
Point Est.	3.52	1.49	2.46	1.47	1.07	1.06	268
Std. Err.	0.47	0.35	0.29	0.21	0.66	0.46	0.25
count	10	19	10	19	12	20	10

Table 7. Poptools stock-recruitment curve fit parameter estimates. Values potentially indicating a non-fit are highlighted in gray.

	Not adjusted for SAR							Adjusted for SAR						
SR Model	a	SE	b	SE	adj. var	auto	AICc	a	SE	b	SE	adj. var	auto	AICc
Rand-Walk	1.50	0.48	n/a	n/a	1.23	0.64	76.2	1.51	0.30	n/a	n/a	0.59	0.49	56.5
Const. Rec	286	72	n/a	n/a	n/a	n/a	66.1	289	54	n/a	n/a	n/a	n/a	54.2
Bev-Holt	32.77	82.67	309	96	0.92	0.51	68.7	4.48	2.39	514	188	0.46	0.33	51.2
Hock-Stk	3.80	0.94	83	0	0.95	0.48	68.4	3.36	0.56	99	0	0.53	0.25	52.7
Ricker	4.09	1.83	0.00355	0.00126	1.18	0.46	72.3	2.64	0.75	0.00197	0.00080	0.53	0.33	53.9

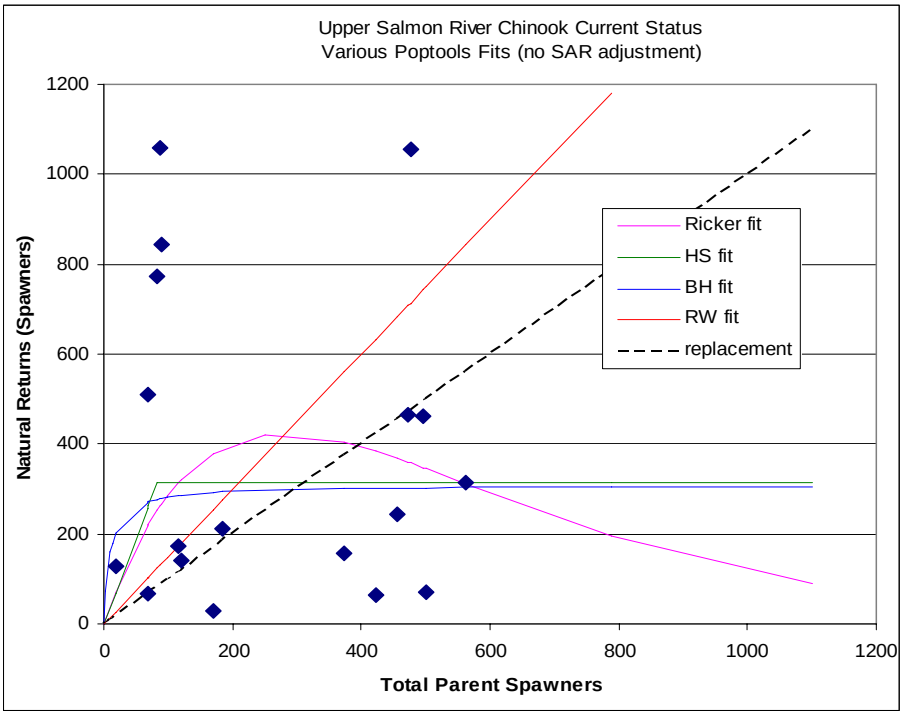

Figure 8. Stock recruitment curves for the Upper Salmon River Chinook population. Data not adjusted for marine survival.

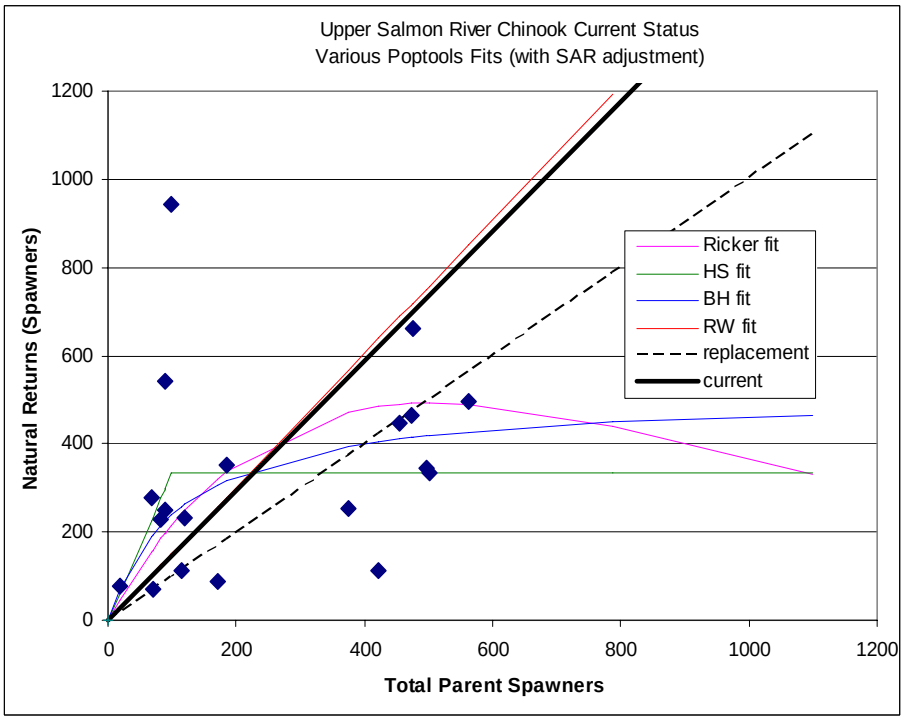

Figure 9. Stock-recruitment curves for the Upper Salmon River Chinook population. Data adjusted for marine survival.